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SCOPING DOCUMENT FOR DEVELOPMENT OF WORKPLAN FOR A SOIL RADIATION SURVEY OF

SANTA SUSANA FIELD LABORATORY AREA IV

BOEING/ROCKETDYNE

Prepared by:

U.S. Environmental Protection Agency
Region 9 and
Radiation and Indoor Environments National Laboratory

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Booz Allen & Hamilton, Inc.
101 California Street, Suite 3300
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1.0 Introduction and Purpose

1.1 Introduction and Project History

The Santa Susana Field Laboratory (SSFL) is located in the Simi Hills of eastern Ventura County, California **(Figure 1)**. In 1946, predecessors of the present site owner, Boeing, Inc., established the SSFL as a rocket engine test site. The 2,700 acre site is divided into four administrative areas (Areas I, II, III, and IV) and a buffer zone. Area IV is the westernmost 290 acres of SSFL. In the early 1950s, the predecessor to the Department of Energy (DOE) began using Area IV to conduct various nuclear programs including nuclear engineering, nuclear research and development, and nuclear manufacturing operations. DOE began phasing out nuclear operations in Area IV in the mid 1960s and ended them in 1988.

The DOE is cleaning up radionuclides at Area IV pursuant to the Atomic Energy Act, (“AEA”) which provides the DOE the authority to “govern the possession and use of special nuclear material, source material, and byproduct material . . . to minimize danger to life or property.” 42 U.S.C. § 2201(b). The DOE began performing removal actions under the AEA at Area IV prior to the passage of the Comprehensive Environmental Response, Compensation, and Liability Act 42 U.S.C. § 9601 et seq. (“CERCLA”) in late 1980. Regarding this removal at Area IV, the DOE has committed to meeting cleanup standards consistent with CERCLA. This goal is also consistent with the Policy on Decommissioning Department of Energy Facilities under CERCLA, which the DOE and the Environmental Protection Agency (EPA) jointly issued on May 22, 1995. This Policy calls for the application of CERCLA to remediation of DOE facilities, but not ongoing AEA removals such as the removal at Area IV.

The DOE is cleaning up chemical contamination at the SSFL under the Resource Conservation and Recovery Act ("RCRA") and the federally approved California Hazardous Waste Control Law. However, the clean-up of radionuclides is not regulated by these laws. *See,* 42 U.S.C. § 6903(27).

The DOE has been conducting decontamination and decommissioning (D&D) of the facilities previously used for nuclear programs. This D&D project involves the characterization, clean-up, and release of buildings or land where radiological materials were used. DOE policies, orders, and regulations guide the D&D process for these nuclear facilities.

Rocketdyne conducted its own nuclear research activities within Area IV. The Atomic Energy Commission (AEC) originally licensed these activities. Later, the licensing authority became the Nuclear Regulatory Commission (NRC). The State of California, as an “Agreement State” under the Atomic Energy Act, became the licensor of these operations. Currently, the California Department of Health Services (DHS) licenses the possession, use, transfer and disposal of radioactive materials (with the exception of special nuclear material, which is still licensed by the NRC). DHS is the regulatory agency formally charged with overseeing the D&D and approving the release of licensed facilities. DHS has no direct authority to regulate DOE facilities. Thus, DOE oversees some operations on the site and DHS provides oversight of others.

In 1994-95, Boeing/Rocketdyne conducted a radiological characterization survey of Area IV (Rockwell International, 1996). This survey covered areas used by both DOE and Rocketdyne for nuclear activities. The purpose of the study was to locate and characterize any unknown areas of elevated radioactivity by surveying areas of the property that had not been previously characterized and/or areas that had not been previously identified as locations of nuclear activities. The survey used an action level of 35-44 millirem per year [(mR/yr) about 4-5 microrem per hour (μR/hr)]. In summary, that study identified three localized areas requiring remediation (this remediation has subsequently been performed). Otherwise, the study concluded that "the radioactivity in Area IV is predominantly from naturally-occurring radioisotopes and radioactive fallout from weapons testing. Ambient radiation levels and soil concentrations of most isotopes were, in general, found to be statistically indistinguishable from local background levels, and the result of factors not related to radiological operations performed in Area IV." The survey found that there was "no significant, widespread contamination of Area IV as a result of radiological operations at the Santa Susana Field Laboratory."

At the present time, the DOE is expecting to vacate the Area IV property and release it back to the landowner, Boeing, Inc., when the environmental restoration is complete. Under terms of a contractual agreement between the DOE and Boeing, Inc., the DOE is expected at this time to leave the Area IV property available for unrestricted land use.

In 1996, EPA was asked (by some members of the community) to perform an independent, technical examination of the DOE's/Boeing/Rocketdyne's D&D activities and radiological characterization work at Area IV. The DOE agreed to EPA's involvement, recognizing that the Agency's independent review might help build public confidence in the DOE's cleanup and closure activities at Area IV.

1.2 Purpose of Scoping Document

In May 2001, EPA Administrator Whitman announced that EPA would conduct a radiological survey of Area IV soils, contingent upon funding from the DOE. The purpose of the proposed survey is to gather data regarding the radiological conditions at the 290-acre Area IV parcel of the SSFL. Using data gathered by this survey, we understand that DOE will perform a risk assessment to determine which areas of the site, if any, will require clean-up to mitigate any risk to human health or the environment consistent with the proposed future unrestricted land use. EPA is conducting this radiological soils investigation to provide the necessary data needed to make this risk determination. EPA will comment on the conclusions reached by the DOE on the appropriateness of the proposed future land use as supported by the risk assessment. While CERCLA authorities are not being strictly (or legally) used by either the DOE or EPA to address the clean-up of Area IV, the DOE has publicly agreed in the past that the release criterion for the site will be within the CERCLA risk range of 10^{-4} to 10^{-6}.

To facilitate timely discussions, and to serve as a basis for an agreement between the DOE and EPA on the funding agreement needed to perform such a survey, EPA has prepared this "Scoping Document" which provides (1) a conceptual approach and rationale for the development and implementation of a radiological investigation workplan, and (2) an estimate of the projected costs associated with that conceptual approach. It is important to recognize that in order to initiate a timely dialogue with the DOE, EPA prepared this Scoping Document based on a limited review of available information on historical site use and data. Thus, EPA does not expect that this Scoping Document serves to provide final and definitive technical guidance for the development of the eventual site survey workplan; ***this document strictly serves to conceptually describe work needed at Area IV, and to provide a gross cost estimate as the basis for funding negotiations with DOE***.

For this survey, EPA anticipates:

- carrying out an intensive historical site assessment,
- conducting a nearly 100-percent surface gamma scan of the site, and
- collecting and analyzing surface and sub-surface soil samples.

EPA will use the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) to guide the design of the surface survey. Superfund Soil Screening Guidance is expected to be used to derive Preliminary Remediation Goals (PRGs) that are within the 10^{-4} to 10^{-6} risk range The data obtained in this survey can be used by the DOE to perform risk assessments.

EPA will hire an independent contractor to conduct the survey. The contractor will create a workplan and a quality assurance program plan (QAPP) which will include appropriate data quality objectives (DQOs). EPA will direct and approve the contractor's work and provide Quality Assurance Quality Control (QA/QC) oversight.

It is hoped that this Scoping Document will serve as a basis for initiating dialogue leading to a formal Interagency Agreement between the EPA and the DOE concerning, among other things, the funding commitment(s) by the DOE for EPA's development and implementation of the Area IV radiological investigation; EPA's role in examining and reviewing the radiological soils conditions at Area IV; and the expected or intended use of the data gathered by the investigation. EPA fully recognizes that the actual cost for the radiological survey won't be known until the completion of the Historical Site Assessment (HSA) and the workplan; thus, EPA anticipates negotiating a funding agreement with DOE that provides flexible terms for the refined scope of work.

This Scoping Document was also prepared with intent to provide information to the community surrounding SSFL and elected public officials on EPA's technical approach to examining the radiological conditions of Area IV soils.

Groundwater sampling and analysis is outside the scope of this survey. However, EPA acknowledges that the evaluation of potential groundwater radiological contamination is critical to fully determine the environmental status of the site, and that conclusions on the appropriateness of the site for future unrestricted use scenarios cannot be made without quality groundwater radiological monitoring data. The existing groundwater monitoring system and ongoing enhancements planned at SSFL are the primary source of information and data. Boeing has been collecting radiological groundwater data during their site-wide monitoring activities for chemical contaminants; these chemical groundwater monitoring activities are under regulatory oversight by the California Department of Toxic Substances Control (DTSC). However, a comprehensive review and focused evaluation of the subset of radiological data must still be performed and addressed separately from this soil survey. EPA will work with DOE/Boeing and the California DHS and DTSC to ensure that the existing/planned groundwater monitoring network at SSFL is used to monitor for radiological contaminants such that the data obtained will conform to standards of accepted scientific practice and quality assurance, and be reliable for making conclusions on the overall environmental status of the site.

Lastly, the additional 180-acre parcel on the northern boundary of Area IV, purchased by Boeing from the Brandeis-Bardin Institute in a 1996 legal settlement (see Figure 1 for location of Brandeis-Bardin Institute), is also not included for consideration in this Scoping Document. This parcel is not part of Area IV, and activities using or producing radioactive materials were not conducted on this property. In 1995, EPA performed a review of Rocketdyne's "Off-Site" study (McLaren-Hart, 1993 and 1994) of this parcel which included independent sample analyses by EPA, DHS and Brandeis-Bardin, and determined, through risk assessment calculations, that the presence of radionuclides found during that study "do not pose a threat to human health or the environment" (EPA Update Fact Sheet, July 1995). The risk assessment calculations at that time were made assuming visiting overnight campers as the most likely exposure scenario. Recent risk calculations involving residential use scenarios (conducted by EPA during the development of this Scoping Document) reaffirm the conclusions based on the earlier calculations. Therefore, EPA did not include a re-examination of the Brandeis-Bardin parcel within this Scoping Document. However, as is true for other off-site parcels contiguous with the 290-acre Area IV footprint, if survey data collected within the scope of the current Area IV-wide survey indicate the need for further examination of these parcels (including the Brandeis-Bardin parcel), EPA recognizes that additional environmental investigations may need to be conducted at such areas.

2.0 Background Information

2.1 Summary of Nuclear Operations and Cleanup Activities in Area IV

The discussion in this section is meant only to provide an overview of nuclear operations and cleanup activities in Area IV based on information provided in company reports. In particular, the report entitled "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective" (Rockwell International, 1989) was the basis for much of the discussion in this section. Critical inputs to the design of the radiological survey are information on the types of nuclear operations conducted at the site, information on where the various operations were conducted and any information regarding incidents involving the release of radioactive materials into the environment.

The types of nuclear operations conducted at the site included (Rockwell International, 1989; pp. 16-17):

1. Operation of nuclear reactors
2. Operation of criticality test facilities
3. Manufacture of nuclear reactor fuel assemblies
4. Disassembly and inspection of nuclear reactors and used nuclear reactor fuel assemblies
5. Fabrication, use, and storage of radioactive sources
6. Preparation of radioactive material for disposal
7. Research on reprocessing of used nuclear reactor fuel
8. Operation of particle accelerators
9. Research using radioisotopes
10. Miscellaneous operations
11. Activities involving commercial items that use radioactive materials.

The locations where these operations were carried out are shown on Figure 2. The nuclear reactors were located along a northeast-southwest trend in the northern portion of the site. Most of the criticality test facilities were also located in the northern portion of the site. The fuel fabrication facilities were generally located south of the reactor locations. The hot laboratory in the southwestern portion of the site was the location for various operations, including disassembly and inspection of nuclear reactors and fuel, and fabrication of radioactive sources including cutting and machining of Cobalt-60. Research on fuel reprocessing was conducted in Building 003 in the northeast portion of the site. Preparation and storage of radioactive material for disposal was carried out in the Radioactive Materials Disposal Facility (RMDF – now known as the Radioactive Materials Handling Facility).

The specific locations of the nuclear reactors are important to note because they provide the primary focus points for the design of the focused soil investigations. The reactor assemblies were located in the ground (subgrade) in concrete-lined cavities or vaults. This arrangement resulted in activation (conversion from non-radioactive to radioactive) of some constituents (i.e., atoms) in the concrete, and in at least one case, resulted in leakage of radionuclides into the sub-surface soils. These areas receive close attention during D&D operations. DOE reports that after sub-surface soils are excavated a radiological verification survey is conducted.

Nuclear operations (other than the nuclear reactors) conducted in Area IV could have resulted in environmental releases if radioactive materials used in the operations were spilled, or otherwise dispersed (i.e., as gas releases, in leach fields, or as particulates). Documented environmental releases of radioactivity include but are not necessarily restricted to: (1) a release of radioactive gases from the Sodium Reactor Experiment in 1959, (2) a release of a dilute solution of fission products to a septic tank leach field at the Radioactive Materials Disposal Facility in 1962, (3) releases of radioactivity from drums or other containers in storage yards, and (4) radioactivity released in the sodium burn pit. According to Boeing/Rocketdyne, "radioactive waste has never been buried at the SSFL" (Rockwell International, 1989; p. 54). Process wastes were shipped offsite for proper disposal.

2.2 Radionuclides of Concern

Radionuclides of concern are those remaining in Area IV that resulted from site operations. A list of radionuclides of concern that has been used by the EPA in presentations at past community meetings is presented in Table 1. For the purposes of this Scoping Document, this list is used as a starting point for selecting the subset of radionuclides that can act as indicators for others and that can be readily analyzed. ***It is important to emphasize that a more definitive list of radionuclides of concern at Area IV will be developed during the actual survey workplan development based on the HSA and other information regarding the use of radioactive materials at the site.*** The radionuclides listed on Table 1 can be grouped according to the processes in which they were generated or used. By grouping the radionuclides in this way, the radionuclide that is most readily detectable can be used as an indicator for the group (see Table 1).

Facilities for the production and storage of new fuel for the nuclear reactors would potentially be contaminated only with the radionuclides contained in the fuel (i.e., isotopes of Pu, Th, U). Such contamination is difficult to identify with gamma surveys because these radionuclides are primarily alpha-emitters (U-235, U-238, Th-228, Th-232, Pu-238 and Pu-239) with only weak gamma-ray signatures. They would not be evident in typical gamma-ray surveys except at relatively high concentrations. At concentrations corresponding to the CERCLA lifetime cancer risk range of 10^{-4} to 10^{-6}, the presence or absence of these radionuclides will be determined by laboratory analysis of soil samples. All the nuclear fuels fabricated and used at the site contained some fraction of Uranium (generally enriched in U-235) with the other component(s) being isotopes of either Plutonium or Thorium. This suggests that analyses of U-235 concentrations in soils could be used to identify areas contaminated with fuel components. However, the raw materials from which the fuels were fabricated may have been composed of single elements (i.e., U, Pu, and Th). Therefore, the main Plutonium (Pu-238, Pu-239) and Thorium (Th-228, Th-232) isotopes are included on the list of "indicator radionuclides" (Table 1).

Reactor operations and, to a much smaller degree, criticality tests produced fission products and activation products. Contamination resulting from reactor operations or from criticality tests could contain the original fuel constituents, fission products and activation products. Contamination associated with facilities in which used reactor fuel assemblies were inspected, reprocessed or prepared for shipment (hot cell, "Hot Cave," and Radioactive Materials Disposal Facility, respectively) could also be expected to contain these radionuclides. Contamination containing fission products and/or activation products can be identified on the basis of the detection of energetic gamma rays emitted by certain fission products in the fuels or in the activation products present in the materials used to house the reactors.

For example, Cs-137 is a fission product normally produced in nuclear fuel during reactor operations. It emits an energetic gamma-ray that is readily detected by standard detection methods and surveys. Therefore, the gamma-ray signal associated with Cs-137 could potentially be used as an indicator of the presence of other radioactivity derived from used nuclear fuels. The element Cs binds strongly to clay particles in the soil (EPA, 1999) and its migration rate through soil is low. Therefore, if Cs-137 was released to surface soils at some time over the operational history of the site, it should still be in the surface soils at this time. If Cs-137 is not detected above background or some other applicable limit at a given location or in a given sample from Area IV, it would be safe to assume the other fission products associated with used nuclear fuels (e.g., Cs-134, Eu-152, Eu-154) were absent as well. However, if Cs-137 were detected in a given area, its presence would not necessarily imply the presence of other radionuclides associated with used nuclear fuels. This is because Cs-137 could have been used independently to fabricate radioactive sources or in some other operation. The fission products Cs-134, Eu-152, and Eu-154 do not appear to have been used independently at the site (Rockwell International, 1989). Therefore, they are not included on the list of "indicator radionuclides" (Table 1).

Contaminated soils containing activation products associated with reactor operations or criticality tests may not contain Cs-137. To detect activation product contamination in soils, the activity of the gamma-ray associated with the activation product Co-60 will be measured. This radionuclide is readily detected using standard gamma counting methods in the field or in the laboratory. As in the case of Cs-137 and fission products, the absence of Co-60 can be used to infer the absence of other activation products (i.e., Na-22, Mn-54, Fe-55, Ni-59, and Ni-63) listed in Table 1. As the exception to this rule, the absence of Cs-137 will not necessarily indicate the absence of H-3 and possibly Na-22. These two radionuclides are mobile in the sub-surface environment and can be separated from the other activation products by common physical processes such as infiltration of rain into the sub-surface soils. Na-22 is included in Table 1 as an indicator radionuclide. H-3 is mainly of concern in groundwater and should be analyzed for in groundwater monitoring investigations.

The fission product Sr-90 does not emit gamma radiation. Therefore, its presence will not be directly evident in gamma scans. Laboratory analysis of this radionuclide (beta particle counting) is required. Therefore, Sr-90 is included in Table 1.

In addition to radionuclides which may remain in Area IV from site operations, the soils contain naturally occurring radionuclides and radionuclides that resulted from world-wide nuclear fallout. The naturally occurring radionuclides include K-40, Ra-226, U-234, U-235, U-238, Th-228, Th-232 (Table 1) and other shorter lived daughter products in the Uranium and Thorium decay chains. The radionuclides associated with world-wide nuclear fallout include Cs-137, Sr-90, and various other radionuclides that are normally present at very low levels of activity. Many of these radionuclides were also produced during operations in Area IV and are listed in Table 1. The radionuclides K-40 and Ra-226 have been added to Table 1 because they contribute substantially to background radiation levels; as such, their detection as background is important to determining the significance of any elevated gamma radiation data.

Table 1: Radionuclides of Concern and Associated Analytical Indicators

Radionuclides of Concern	Analytical Indicator
Radionuclides Contained in Fuel	
Americium 241 (Am-241)	The presence of Pu-238 or Pu-239 may indicate presence; absence of Pu-238 and Pu-239 indicates absence
Plutonium 238 (Pu-238)	***Indicator Radionuclide**; may be present alone*
Plutonium 239 (Pu-239)	***Indicator Radionuclide**; may be present alone*
Plutonium 240 (Pu-240)	The presence of U-235 may indicate presence; absence of U-235 indicates absence
Plutonium 241 (Pu-241)	The presence of U-235 may indicate presence; absence of U-235 indicates absence
Plutonium 242 (Pu-242)	The presence of U-235 may indicate presence; absence of U-235 indicates absence
Thorium 228 (Th-228)	***Indicator Radionuclide***
Thorium 232 (Th-232)	***Indicator Radionuclide**; may be present alone*
Uranium 235 (U-235)	***Indicator Radionuclide**; all fuels likely enriched with U-235, its presence is indication of the possible presence of other radionuclides contained in fuel*
Uranium 238 (U-238)	The presence of U-235 may indicate presence
Fission Product Radionuclides	
Cesium 134 (Cs-134)	The presence of Cs-137 may indicate presence; absence of Cs-137 indicates absence
Cesium 137 (Cs-137)	***Indicator Radionuclide**; its presence indicates other fission products may be present; its absence indicates they are not*
Europium 152 (Eu-152)	The presence of Cs-137 may indicate presence; absence of Cs-137 indicates absence
Europium 145 (Eu-145)	The presence of Cs-137 may indicate presence; absence of Cs-137 indicates absence
Strontium 90 (Sr-90)	*Sr-90 will be analyzed independently*
Activation Product Radionuclides	
Cobalt 60 (Co-60)	***Indicator Radionuclide**; its presence indicates the other activation products may be present, its absence indicates they are not present*
Iron 55 (Fe-55)	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Manganese 54 (Mn54)	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Nickel 59 (Ni-59)	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Nickel 63 (Ni-63)	Presence of Co-60 may indicate presence; absence of Co-60 indicates absence
Sodium 22 (Na-22)	***Indicator Radionuclide**, of concern mainly in sub-surface soil*
Tritium (H-3)	Of concern mainly in groundwater, recommend analyzing for in groundwater investigations
Naturally-Occurring Radionuclides	
Potassium 40 (K-40)	***Indicator Radionuclide**; presence of K-40 is very high in site soils*
Radium 226 (Ra-226)	***Indicator Radionuclide***
Thorium 228 (Th-228)	***Indicator Radionuclide***
Thorium 232 (Th-232)	***Indicator Radionuclide**; may be present alone*
Uranium 234 (U-234)	***Indicator Radionuclide***
Uranium 235 (U-235)	***Indicator Radionuclide***
Uranium 238 (U-238)	The presence of U-235 may indicate presence

2.3 Natural Characteristics of Area IV

Area IV is situated atop the Simi Hills that lie due west of the San Fernando Valley and due south of the Simi Valley (Figure 3). Area IV is morphologically complex with a central area of low topographic relief ("mesa") surrounded by rocky areas. The southwest portion of Area IV contains large rock outcrops and is at a higher elevation than the central area. The area to the north is dominated by a rocky slope several hundred feet in height that leads into a series of densely vegetated gullies and ravines. On more level terrain further to the north, lies the Brandeis-Bardin Institute. To the south and east there are ravines and rocky terrain associated with Areas I-III and undeveloped land owned by Boeing, Inc.

Area IV is underlain by Eocene-Cretaceous sedimentary rocks. Because this part of eastern Ventura County and western Los Angeles County is geologically complex, an expert evaluation of the local geology will be required to select appropriate offsite areas to be surveyed for background naturally occurring radioactivity. Vegetation in Area IV includes stands of oak trees and scrub brush with local concentrations of poison oak. The presence of poison oak must be factored into the survey design. Where possible, areas containing dense concentrations of poison oak must either be cleared (if possible), worked around, or avoided altogether. During development of the workplan for the Area IV survey, consideration must be given to the protection of any endangered or protected species that may reside on the site. The "Biological Conditions Report, Santa Susana Field Laboratory, Ventura County, California," is a source of data on endangered and protected species at the site.

2.4 Previous Surveys of Area IV

The discussion in this section is provided as a brief overview of some of the major radiological investigations and cleanup activities that have been carried out at the site. Radiological monitoring of the environment at Area IV has been ongoing since 1954. Oversight/inspection activities for the monitoring program were initiated by the AEC and successor organizations (DOE and NRC) in 1956 and 1974, respectively. The results of this monitoring program have been reported to the public in annual Environmental Monitoring and Facility Effluent Reports. According to the Rockwell International Report (1989): "The results of this environmental monitoring indicate that there are no significant sources of unnatural radioactive material in the vicinity of the Rocketdyne sites."

In 1985, a Radiological Survey Plan for the SSFL was prepared (Rocketdyne, 1985) "to determine if any man-made radioactive contamination existed in areas it was not known to be, and to locate and quantify any such contamination if it existed." This targeted survey included 25 locations within Area IV. Most of these locations were buildings although salvage yards, storage yards, landfills, and open fields were also included. Contamination exceeding regulatory limits in force at the time was found in 6 of the 25 locations surveyed (Rockwell International, 1989; Table 4). The contaminated areas identified in this survey have since been remediated to cleanup levels in force at the time of remediation.

Decontamination and Decommissioning of Area IV buildings and facilities have been ongoing since the early 1980's. These activities resulted in closeout radiological surveys by various organizations including Argonne National Laboratory (ANL), Oak Ridge Associated Universities (ORAU), Oak Ridge Institute for Science and Education (ORISE), and the California DHS. Some of these buildings have not been demolished and are currently being used for non-radiological work.

Boeing/Rocketdyne conducted a Radiological Characterization Survey in 1994-1995 to provide "comprehensive coverage" of the land in Area IV. The survey did not include buildings, facilities in the process of being remediated, inaccessible areas (i.e., steep rocky slopes or thick brush areas), or "areas previously characterized in earlier programs" (Rockwell International, 1996). The survey included an ambient gamma survey, a walk-about gamma survey, and soil and water sampling with laboratory analysis of H-3, Cs-137, Sr-90, U-234, U-235, U-238, Th-228, Th-230, Th-232, Pu-238, and Pu-239.

Background concentrations of naturally-occurring radionuclides for the 1994-95 ambient gamma survey were derived from a combination of data obtained in separate surveys. Rocketdyne surveyed selected background locations in 1992 and 1994 (McLaren/Hart, 1993; 1994). In 1995, Rocketdyne resurveyed three (3) locations utilized in the earlier survey (i.e., those locations closest to Area IV). A mean value of 15.6 ± 3.6 μR/hr was derived for the background gamma level appropriate to Area IV. For soil samples analyzed in the laboratory, the results of the McLaren/Hart (1993, 1994) background soil sample analyses were used. These were augmented with the results for Uranium and Thorium analysis on six additional samples obtained by Rockwell International to fill gaps in the earlier survey.

For the 1994-95 ambient gamma survey, a radiation level of 5 μR/hr above the average of the background data set was used to identify "locations with elevated gamma" (Rockwell International, 1996). A total of 12 locations were identified as having "elevated gamma" readings. Soil samples were taken at these 12 locations and four others and all of these were analyzed for the radionuclides listed above. According to the survey report (Rockwell International, 1996), "Six (6) of these locations showed no unusual soil isotope levels. Seven (7) locations exhibited slightly elevated soil radioisotopes concentrations above background, but nevertheless well below regulatory cleanup levels. Three (3) locations exhibited radionuclide levels above background and above cleanup levels." The latter three locations have since been remediated. The results of the walk-about survey were not detailed in the survey report.

The 1994-95 Area IV soil sampling data (149 soil samples) identified 27 samples "as having possibly higher than local background radioisotope concentrations" (Rockwell International, 1996; p. 61). Of these, a total of 24 samples "have isotope concentrations well below regulatory cleanup levels, in most cases within the range of U. S. background and do not require any further remediation." Of the three remaining locations, one was considered a natural deposit and the other two locations contained Cs-137 resulting from site operations. All three of these locations have since been remediated.

A total of four water samples were collected and analyzed from Area IV– all four from the Sodium Reactor Experiment (SRE) pond. This sampling concluded that "all detected isotopes in the water samples are well below the federal and state drinking water supply

Maximum Concentration Levels (MCLs)" (McLaren/Hart, 1993 and 1994).

A local stakeholder group called The Committee to Bridge the Gap (CBG) submitted comments on the Area IV Radiological Survey (Rockwell International, 1996). Several of the comments submitted concerned the manner in which background values were obtained. Several other comments concerned areas with contamination or areas that had been remediated but still showed readings above background.

Comments submitted by the EPA also noted problems with the determination of background. In addition, EPA had concerns with survey grid distances, gamma detector calibrations, detection of radionuclides at depth, the follow-up on anomalies, inconsistent presentation of laboratory data in different parts of the report, and the fact that areas under remediation were excluded from the survey.

Rockwell International responded to the comments from the CBG and the EPA on the Area IV Radiological Survey (letter dated June 5, 1997 to Tom Kelly, EPA, from P. Rutherford, Boeing, Inc.). However, it appears that this letter did not resolve all of EPA's comments. In a letter dated July 11, 1997, EPA relayed to Rockwell International its outstanding concerns regarding the overall quality of the survey and requested that Boeing redo the survey.

3.0 Proposed Scope of EPA's Area IV Radiological Survey

For the purposes of this Scoping Document, the following assumptions have been made:

(1) The survey will include only Area IV (i.e., the Brandeis-Bardin property is excluded from the scope of this survey), as discussed in Section 1.

(2) Radiological impacts to groundwater in the area are outside the scope of this survey, as discussed in Section 1.

(3) Radiological surveys of buildings as addressed by D&D activities are excluded from consideration.

(4) The sub-surface radiological survey is intended to address a potential and future surface grading or an excavation scenario in which either the land surface is regraded with the resulting soil spread over the surface or when a below-grade swimming pool is constructed and the excavated soil is spread over the property. The sub-surface survey design addresses these scenarios by using a risk-based approach.

The survey will include surface soils and sub-surface soils in Area IV. The design of the surface soil survey will follow MARSSIM guidance (EPA, 2000) that will require surface soil sampling over much of Area IV. The surface gamma scan portion of the MARSSIM survey will include as much of the site area as is practicable. Some areas may be excluded because they are inaccessible to the surveying equipment, for example, rock outcroppings, dense vegetation, and existing buildings. The portions of Area IV that are accessible will be considered for 100% coverage. In addition to following the MARSSIM guidance, additional locations to be tested will be determined from an assessment of historical site information.

A radiological survey of sub-surface soils in Area IV is more difficult to design because agency guidance is less definitive. Surveying of sub-surface soils is presently outside the scope of MARSSIM guidance. The design of the sub-surface soil survey is risk-based. The approach proposed in this Scoping Document for the sub-surface soil survey is tiered so that areas most likely to have been contaminated are given more attention than areas less likely to be contaminated based on the HSA. The information obtained from the HSA will be used to create a site conceptual model that indicates the likely locations to find radionuclides of concern based upon locations of use and fate and transport of individual constituents. The sub-surface sampling requirements will also be based on the site conceptual model and data evaluation from the gamma survey results and the surface soil analysis results.

4.0 Survey Approach

The approach for surface soils will follow MARSSIM guidance.

The overall survey design must remain flexible enough to allow for modifications to the sampling plans if new information is obtained after the beginning of the Area IV survey.

A major issue in this survey will be the measurements used to define background. The approach and methodology for obtaining these measurements will include a review of existing data and will include input from stakeholders. However, EPA will make the final determination regarding background measurements.

EPA will conduct oversight of the contractors throughout the workplan development and the implementation of the surface and sub-surface surveys. The EPA will maintain a review and approval role in the development of the survey workplan by contractors. The agency will also conduct QA/QC activities associated with the survey as defined further in Section 6.

4.1 Surface Soil Survey

In the design of the surface soil survey, MARSSIM guidance will be followed. MARSSIM requires that Derived Concentration Guideline Levels (DCGLs) be derived before the survey can be planned. For the purposes of this Scoping Document, PRGs were used as the preliminary DCGLs. The PRGs were calculated according to the Superfund Soil Screening Guidance (i.e., RAGS risk model) using default values for the input parameters. For this Area IV survey, the total lifetime cancer risk range of 10^{-4} to 10^{-6} will be used to derive the final site-specific DCGLs. Data quality objectives will be defined in the development of the workplan and the QAPP.

EPA proposes a surface gamma scan survey that covers as much of the accessible and impacted site areas as possible using readily available equipment. The gamma scan will measure the gamma-ray activity in soils in Area IV using a calibrated, stable, mobile measuring system sufficiently sensitive to measure activities associated with the 10^{-4} to 10^{-6} CERCLA risk range. The scanning system will be equipped with a Global

Positioning System (GPS). According to the report on the 1993-94 survey (Rockwell International, 1996), approximately 80% of Area IV should be accessible to the mobile gamma scanning. This implies, for cost estimating purposes, that approximately 240 acres may be scanned.

The gamma scan will identify any anomalous areas of gamma activity on the soil surface. Anomalous areas will be further investigated with an in-situ counting system (i.e., gamma spectrometer) to rule out the possibility that the anomalous reading was due to naturally occurring radionuclides. If naturally occurring radionuclides are ruled out as the source of the anomalous activity, surface samples will be collected and analyzed.

MARSSIM guidance requires that the impacted area be divided into three types of survey units that reflect the degree to which an area is thought to be contaminated. Class I survey units are *likely* to contain contamination *above* acceptable levels. Type II survey units are *suspected* of being contaminated. Type III survey units are *most likely not* contaminated to unacceptable levels. For the purposes of estimating costs in this Scoping Document, it is estimated that Area IV contains 40 acres of MARSSIM Class 1 survey units, 50 acres of Class 2 survey units, 150 acres of Class 3 survey units, and 50 acres of not accessible or non-impacted land. The estimate of 40 acres of Class 1 survey units is based on present knowledge of areas that used or produced radioactive materials. Non-impacted lands are areas that have no reasonable potential for residual radioactive contamination. The assumed Class 1 and/or Class 2 acreage will be more accurately defined on the basis of information obtained during the historical site assessment. This may result in a change in the total number of surface soil samples to be collected.

The MARSSIM survey units in Area IV will be gridded for the purpose of establishing soil sampling locations. For cost estimating purposes of this Scoping Document, the number of soil samples taken for the MARSSIM survey has been based on 50 samples/acre for Class1 survey units, 50 samples/5 acres for Class 2 survey units, and 50 samples/10 acres for Class 3 survey units.

Assuming the acreage and classifications stated above, up to 3,250 surface soil samples could be taken for the MARSSIM survey. This number does not include additional QA/QC samples. The soil sampling will follow EPA established procedures and will include QA/QC sampling by EPA. Each of the samples obtained will be analyzed for the (indicator) radionuclides of concern, as appropriate.

Background will be determined at several offsite locations. The background reference areas selected should be undisturbed and have similar physical, chemical, geological, and biological characteristics as the survey unit being evaluated. An expert on the local geology (i.e., geologist) will be consulted to identify such locations. The size of the background areas must be the size of the survey unit in MARSSIM. Upon consideration of these and other site-specific factors, the actual number of discrete background locations will be determined. Based on historical community concerns regarding background location determinations, the number of background areas and their locations will include input from stakeholders. The background reference areas will be surveyed with the same soil sampling and analytical protocols and gamma scanning used for the soils in Area IV. For purposes of cost estimating, we assumed that up to six geographically discrete, 10-acre locations might be used to determine background radiation levels in this area.

4.2 Sub-Surface Soil Survey

Sub-surface soils are here defined as the nonlithified materials present below one (1) foot depth and above the depth of refusal (i.e., hard rock) using typical soil boring equipment.

The selection of locations for sub-surface sampling will be heavily influenced by the results of the historical site assessment. That is, sub-surface sampling activities will emphasize those locations where there was a potential for the dispersion of radioactive materials into the sub-surface environment. Such locations would include areas where radioactive materials were used or could have migrated (e.g., buildings, leach fields, drain pipes, etc.). The selection of sub-surface locations will also be influenced by the results of the surface gamma survey. That is, areas with elevated gamma activity will be preferentially targeted.

The procedure for the location of sub-surface sampling sites will involve prioritization of the operations areas/facilities in Area IV according to historical information on sub-surface contamination, the results of the surface gamma scan, and radionuclide concentrations measured in soil samples. The highest priority (Type 1) will be given to areas/facilities which were known to be associated with contaminated sub-surface soils. The second highest priority (Type 2) will be given to the areas/facilities in which contamination was present in the facility or surface soils but not necessarily in sub-surface soils, according to available records or the results of the surface gamma scan. The third highest priority (Type 3) will be given to those facilities where radioactive materials were handled but which are not known to be associated with contamination or with contaminated sub-surface soils. The fourth highest priority (Type 4) will be given to other facility/building sites, roads and other areas used in operations at the site (parking lots, etc.). The fifth highest priority (Type 5) will be given to areas not known to be contaminated and not used in operations at the site but that could be impacted by operations at the site. The lowest priority (Type 6) will be given to the areas not known to be impacted by site operations.

The procedure for sub-surface soil sampling will involve drilling a borehole with an auger and sampling soil at three depths (zero to six inches, five feet and 10 feet). Sub-surface soils less than 10 feet in thickness will be sampled at zero to six inches and at the point of refusal. The sampling depth of 10 feet is based on practice and guidance from EPA Superfund Region 9, including the State of California Supplemental Guidance for Multi-media Risk Assessment for Hazardous Waste Sites and Permitted Facilities (July 1992, Office of Science Advisor).

For cost estimating purposes, the number of boreholes to be drilled in each type of area will be related to the MARSSIM class assignments used for the surface soil survey. For Type 1 and 2 areas, 51 sub-surface soil samples/acre will be taken. This implies 17 boreholes will be drilled in each acre of Type 1 and 2 areas. For Type 3 and 4 areas, 51 sub-surface soil samples will be taken per five acres. This implies 17 boreholes will be drilled in each five-acre Type 3 and 4 parcel. Finally, for Type 5 and 6 areas there will be no sub-surface samples taken unless the MARSSIM Class 3 survey reveals surface soil anomalies. For purposes of this Scoping Document, it is assumed there will be 40 acres of Type 1 and 2 areas, 50 acres of Type 3 and 4 areas; this implies 850 boreholes will be drilled. In summary, for cost estimating purposes, a total of 850 boreholes (2,550 soil samples) were assumed.

In addition to onsite boreholes, a representative number of boreholes will be drilled in background areas. For cost estimating purposes, it is assumed there will be six background areas. For the Type 1 and 2 areas (MARSSIM Class 1 survey units), three boreholes are expected to be drilled at random locations. In each of the three boreholes, there will be a sample taken at the zero to six-inch, five-foot, and 10-foot levels. The data for samples from each depth will be averaged to develop the mean for a specific depth. For the Type 3 and 4 areas (MARSSIM Class 2, five-acre survey units), two boreholes are expected to be drilled at random locations outside the one-acre Class 1 area but within the five-acre Class 2 area. The data for samples from each depth in these two boreholes will be combined with the data averaged from samples obtained at similar depths from the each of the three Class 1 area boreholes. The data for these three samples will be averaged and this average will be used as the mean background for that specific background location and for that depth for the Type 3 and 4 sub-surface soil areas. With six locations, for cost estimating purposes this equates to 30 boreholes with six background locations and 90 sub-surface samples.

4.3 Data Analysis and Reporting

All the data obtained shall be presented in hard-copy and electronic media. Maps showing survey parameters including MARSSIM class locations, grid systems, sampling locations, areas of elevated activity, and other parameters of interest will be presented. The laboratory analyses of QA/QC samples shall be evaluated to determine if sampling data meet data quality objectives. This process will start early in the analysis phase and continue until the end. Once the data are qualified, the laboratory analyses of background (reference area) samples shall be evaluated to derive appropriate statistical parameters (i.e., type of distribution, mean, median, standard deviation, standard deviation of the mean, etc.). These data shall be presented for each radionuclide of concern in each background area sampled and for each type of MARSSIM survey unit in each area. The statistical data for the different background areas shall be compared to test for statistical differences and to derive statistical parameters for background overall. Appropriate graphics will be included to depict statistical results. If appropriate, statistical differences between background (reference) areas shall be evaluated in terms of differences in geological, topographical or other parameters.

The results of laboratory analyses of onsite samples shall be evaluated for compliance with DQOs by the EPA. Once the data are qualified, these data can be evaluated in relation to the DCGLs derived for Area IV surface and sub-surface soils. This evaluation will include full statistical analysis as indicated by appropriate regulatory guidance. The results of these evaluations will be presented in appropriate tabular and graphical formats.

5.0 Cost Estimate

A gross cost estimate complement to the conceptual radiological survey contained in this Scoping Document was developed by using parametric cost estimating tools and based on the best available data and assumptions as described in this document. This budget represents an estimate of costs to conduct the HSA, determine background site radiation levels, conduct site surveys, and follow QA/QC protocols to monitor the accuracy of the surveys. The costs are estimated based on fiscal year (FY) 2001 dollars.

The estimated costs of the survey program are summarized as follows.

Activity	**Estimated Cost**
Historical Site Assessment (includes workplans and reports)	$400,000
Survey Scoping	$153,000
Gross Gamma Survey	$962,000
Background Determination	$2,008,000
Surface Soil Survey	$6,051,000
Sub-surface Soil Survey	$5,809,000
QA/QC Monitoring Requirements	$2,751,000
Total Estimated Cost	**$18,134,000**

The primary cost components of these activities include: sampling teams, borehole drilling, technical analysis of data, and laboratory analyses.

5.1 Schedule

Based on our understanding of DOE's current schedule for site restoration, including factors such as completing the D&D program activities and removal of radioactive waste, an initial schedule of activities was determined. The overall schedule is based on a five-year plan to complete all activities outlined in this document. The proposed schedule allows the work outlined in the document to begin while accounting for DOE's ongoing activities. It also provides time for the analytical laboratory tests in each area to be completed and the results evaluated before continuing further sampling. An outline of the expected activities is provided below:

Year 1
- Historical Site Assessment
- Survey Scoping and Workplan Development
- Background Radiation Level Investigation

Year 2
- Gross Gamma Survey of MARSSIM Class 3 survey units
- Completion of MARSSIM Class 3 and 2 surface soil surveys
- Completion of Type 3 and 4 sub-surface soil surveys

Year 3
- Gross Gamma Survey of MARSSIM Class 1 and 2 survey units
- Completion of approximately 50 percent of MARSSIM Class 1 surface soil sampling

Completion of approximately 50 percent of Type 1 and 2 sub-surface soil sampling

Year 4

Completion of remaining 50 percent of MARSSIM Class 1 surface soil sampling

Completion of remaining 50 percent of Type 1 and 2 sub-surface soil sampling

Year 5

Conduct final QA/QC and analytical data validations

Prepare final report

This schedule was developed to allow for an evenly distributed flow of funding with the highest level of funding probable in years 3 and 4.

5.2 Historical Site Assessment and Reports

The historical site assessment is planned as the initial task. It is estimated that this effort will require three people approximately nine months to complete. The cost estimate for this task also includes the estimated cost for completing required project plans such as the QAPP and Health and Safety Plan. An additional one month of effort is estimated to complete the final report.

5.3 Survey Scoping

The survey scoping phase is estimated to be completed primarily in the first and second years of the project. The primary activities in this phase are to classify the areas at the site into the three MARSSIM classes. This is estimated to require three months of time. Another activity is to develop the DCGLs (this is estimated to take about six months). These activities are to be supported by a detailed site survey. It is estimated that it will take a survey team three weeks to complete the survey. The final activity includes documenting the findings and analyses from these activities.

5.4 Gross Gamma Survey

The gross gamma survey estimate is based on a contractor's estimate of costs to conduct the survey. The survey is expected to be completed in two parts. The first part will include a gross gamma survey of the MARSSIM Class 2 and 3 areas. The second part will include a survey of the MARSSIM Class 1 area. The estimate also includes costs to clear the site in preparation for the survey and prepare final reports. The potential need for additional sampling based on the gross gamma survey was accounted for in the cost estimate. It is estimated that approximately 100 surface soil samples and 20 sub-surface soil samples may need to be obtained and analyzed for this effort.

5.5 Background Determination

It is estimated that up to six background locations might be sampled. To complete the determination, each of the six sites will need to be surveyed. A sampling crew will then take surface and sub-surface soil samples at each of these sites. Additional materials will be collected to develop spiked and double-blind QA/QC samples. The costs for preparing spikes and double-blind QA/QC samples are included in this part of the overall estimate. The number of samples estimated to be collected and analyzed for the background determination is 990 samples.

5.6 Surface Soil Survey

The surface soil survey is estimated to take place in three phases. The first phase will consist of sample collection, laboratory analysis, and reporting results from MARSSIM Class 2 and 3 areas. The second and third phases will consist of sampling and analysis of MARSSIM Class 1 areas over the course of two years. It is estimated that it will take a team approximately one-month to collect the samples during each of the phases. A series of final reports documenting the results by each phase will be completed. During the surface soil survey, approximately 3,250 samples will be collected for analysis.

5.7 Sub-Surface Soil Survey

The sub-surface soil survey is estimated to take place in three phases. The first phase will consist of sub-surface sampling in the Type 3 and 4 soil areas. The second and third phase will consist of sub-surface sampling in the Type 1 and 2 soil areas. The samples are estimated to be taken from 10 foot boreholes. It is estimated that 850 boreholes will be necessary for the sub-surface survey. This includes requirements for samples taken through or under existing roadbeds, parking areas, and the estimated two remaining building slabs. During the sub-surface soil survey an estimated 2,550 samples will need to be analyzed.

5.8 Quality Assurance Quality Control Requirements

EPA's National Air and Radiation Laboratory will evaluate whether the sampling and analysis activities meet the required DQOs. To perform this task, the lab will obtain and analyze 1,436 QA/QC samples of the background, surface, and sub-surface soils. An auditor, field technician, and principal scientist will perform the required oversight and onsite audit functions. The program will need their support during the four years of actual sample collection and analysis. The combined efforts of this staff are estimated to be 2.25 full time employees.

5.9 Potential Cost-Saving Measures

Among others, the following factors can each have a major impact on the cost estimate for the overall survey: (1) the number of acres in the MARSSIM Class 1 category, (2) the number of analytes per sample, and (3) the number of background sampling locations. Any reductions from the estimates for these factors could have significant cost-saving potential.

The number of acres of MARSSIM Class 1 survey units has been estimated at 40 acres for the purposes of this document. However, once the historical site assessment is completed, 40 acres may be an overestimation. If so, the difference between the new number and the estimated number could correspond to significant cost savings.

There also exists a potential for significant cost savings in the number of analytes that are considered. In particular, if the number of analytes considered in a subset of samples could be justifiably decreased, substantial cost savings could result. The following discussion provides a potential basis for lowering the number of analytes in a subset of the sub-surface samples to be collected.

Because most of the radionuclides of concern (i.e., Am-241, Cs-134, Cs-137, Eu-152, Eu-154, Fe-55, Mn-54, Ni-59, Ni-63, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Ra-226, Sr-90, Th-228, and Th-232) usually have high affinities for sorption onto soil particles (EPA, 1999), they will be retained in near-surface soils. This collection of radionuclides is called the "strongly sorbed" group. Exceptions to this behavior may include the radionuclides H-3, Na-22, and the Uranium isotopes. Tritium (H-3) can move at the same rate as infiltrating waters. The activation product Na-22 tends to have small values for sorption coefficients (Kd<10) in soils of the type present in Area IV. Uranium sorption coefficients are small in well-aerated (i.e., oxygenated) soils low in organic-debris content but can be large in organic soils. Given the climatic conditions in Area IV (i.e., semi-arid) , Uranium sorption coefficients will likely be on the low end of the range. This group of "weakly sorbed" radionuclides are those most likely to be transported into sub-surface soils by locally infiltrated rain or surface waters.

Therefore, where appropriate, it is suggested that a phased approach be taken with respect to the analyses of radionuclides of concern in the two deeper sub-surface samples taken in each borehole. If after analysis of the 5- and 10-foot samples in the first 50 boreholes (or some other appropriate number of boreholes defined during workplan development) there are no detections above background (plus two sigma) for the strongly sorbed radionuclides, then the analyses for these radionuclides in the 5- and 10-foot samples could be eliminated in the remainder of the boreholes where the historical site assessment does not suggest the potential for contamination at depth. However, analyses of the weaker sorbed radionuclides should be carried out for all three samples from each borehole.

For the purpose of cost estimation, the number of background locations to be sampled was projected as six. However, a more detailed analysis of background locations and statistics may find that three or four locations may well be adequate. If so, the reduction in sampling and analytical costs associated with a smaller number of background locations could be significant.

6.0 Contractor Monitoring and Oversight by EPA

In order to provide adequate monitoring of the EPA contractor performing the work on the SSFL Soil Survey, the following actions in the following areas will be taken by EPA Radiation and Indoor Environments Laboratory to assure reliable results are obtained.

6.1 Historical Data

Historical data will be used to determine MARSSIM Class 1 through 3 survey units for surface soil contamination and determine where sub-surface soil samples will be collected and analyzed. The expectation is that the contractor will conduct a detailed and thorough evaluation of historical information.

The contractor shall prepare a QAPP for qualification of historical data in accordance with EPA QA/R-5 (EPA 2001) and EPA QA/G-5 (EPA 1998).

6.2 Survey Quality Assurance Project Plan

The contractor shall prepare a QAPP for collection and analysis of survey data in accordance with EPA R-5 and EPA G-5. Procedures to be used by the contractor shall be referenced, performance based, or have a detailed basis in the scientific literature prior to being approved by EPA for this project. EPA shall approve the QAPP and monitor compliance with it.

6.3 EPA Personnel On Site During Survey

EPA will monitor contractor activities during the ground survey and during the soil sample collection process by on site audits and direct work inspection. Audits will be conducted to assure compliance with the QAPP. EPA will be on site for announced and unannounced audits. Direct work inspection will be formalized by EPA procedure and documented in a contractor oversight record, further reviewed by senior EPA project leaders.

6.4 EPA R&IE Lab Direct Gamma Scanning Quality Control

As part of quality control monitoring, EPA will replicate, with its own systems and equipment, ground scanning at a minimum of 10 percent of the site, focusing primarily on Class 1 areas.

6.5 EPA Quality Control Samples

EPA will split certain samples, both surface and sub-surface, with the contractor. EPA will use the same performance-based DQO as the contractor in its analysis. EPA will also perform duplicate analysis on some samples in the laboratory (percentage to be determined), produce spiked samples with off-site soil and analyze them (percentage to be determined). In the case of sample locations where random samples per class unit are to be collected, collect them at the next location given in the random number calculation (percentage to be determined).

EPA will also prepare spike samples from off-site soil and have the onsite contractor mark and place the samples in the laboratory contractor sample queue. These samples will appear to be legitimate samples and will not follow a predictable pattern (blind to the laboratory contractor). This percentage will be determined, but more emphasis will be placed on the higher MARSSIM survey unit classifications than the lower ones. Blind samples would also be introduced as QC samples into the EPA lab as part of contractor monitoring.

6.6 Laboratory Oversight and Quality Assurance Quality Control

Both the contract laboratory and the EPA laboratory verifying the performance of the contract laboratory would be subject to audit. EPA will perform audits on contract laboratories directly, using guidance from Superfund and National Environmental Laboratory Accreditation Conference as a basis for the audit.

6.7 Assessment of Assumptions in the Conceptual Site Model

EPA will review technology and applicability of technology to handle remote or inaccessible areas of the site which might have been affected by spills, runoff, or dumping. EPA will review and concur on any models used to predict contamination or lack thereof on inaccessible locations.

6.8 Data Validation

The contractor will be required to validate its own work - data packages will be electronic, backed up by a complete paper trail. EPA will validate a representative set of contractor data (percentage to be determined). EPA will internally validate its own data and outside auditors will review this for accuracy.

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List of Figures

Figure 1: Site Location Map

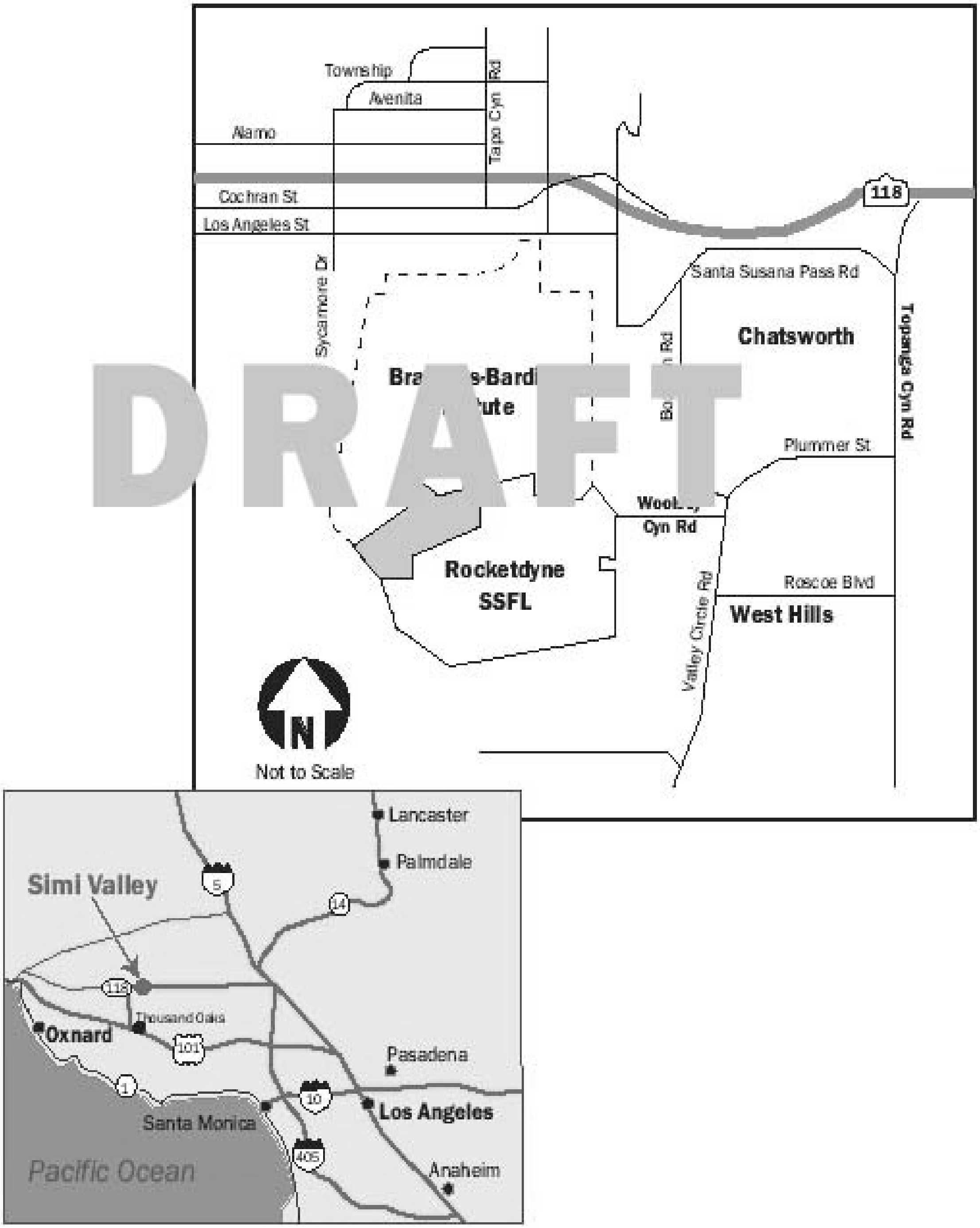

Figure 2: Area IV Detail Map

Figure 3: Aerial Photograph of Area IV